

CLAIMS

What is claimed is:

1. A direct methanol fuel cell comprising:
  - (a) a solid fluorinated polymer electrolyte membrane having an ion  
5 exchange ratio (IXR) of at least about 17, wherein the solid polymer  
electrolyte membrane has a first surface and a second surface; and
  - (b) at least one catalyst layer present on each of the first and second  
surfaces of the solid polymer electrolyte membrane; wherein the fuel cell is  
operated at a temperature of less than 60 °C; and wherein the methanol  
10 cross-over rate is reduced by at least about 20 %; and the power output is  
equal to or increased up to about 15%, versus a fuel cell comprising a  
solid fluorinated polymer electrolyte membrane having the same  
thickness, and an ion exchange ratio (IXR) of about 15.
2. The direct methanol fuel cell of Claim 1 wherein IXR is 17 to 29.
- 15 3. The direct methanol fuel cell of Claim 2, wherein IXR is 19 to 23.
4. The direct methanol fuel cell of Claim 3, wherein IXR is 23.
5. The direct methanol fuel cell of Claim 1, wherein the  
temperature is about 50 to about 55 °C.
6. The direct methanol fuel cell of Claim 1, wherein the  
20 temperature is about 40 to about 50 °C.
7. The direct methanol fuel cell of Claim 1, wherein the  
temperature is about 20 to about 40 °C.
8. The direct methanol fuel cell of Claim 1, wherein the power  
output is increased by about 5 to about 15%.
- 25 9. The direct methanol fuel cell of Claim 8, wherein the power  
output is increased by about 10 to about 15%.
10. The direct methanol fuel cell of Claim 1, wherein the thickness  
of the membrane is 175 $\mu$ , the IXR is 23, and methanol cross-over rate is  
reduced by 60%.
- 30 11. The direct methanol fuel cell of Claim 1, wherein the thickness  
of the membrane is 250 $\mu$ , the IXR is 23, and methanol cross-over rate is  
reduced by 75%.

12. The direct methanol fuel cell of Claim 1 wherein the solid fluorinated polymer electrolyte membrane is a perfluorinated polymer.

13. The direct methanol fuel cell of Claim 12 wherein the perfluorinated polymer comprises a carbon backbone and at least one  
5 side chain represented by the formula  $-(OCF_2CFR_f)_a-OCF_2CFR'_fSO_3Y$ , wherein  $R_f$  and  $R'_f$  are independently selected from F, Cl or a perfluorinated alkyl group having 1 to 10 carbon atoms,  $a = 0, 1$  or  $2$ , and  $Y$  is H, an alkali metal, or  $NH_4$ .

14. The direct methanol fuel cell of Claim 12 wherein the  
10 perfluorinated polymer comprises a carbon backbone and at least one side chain represented by the formula  $-O-CF_2CF_2SO_3H$ , or a salt thereof.

15. The direct methanol fuel cell of Claim 13 wherein the polymer has an IXR of about 17 to about 29.

16. The direct methanol fuel cell of Claim 14 wherein the polymer  
15 has an IXR of about 17 to about 29.

17. The direct methanol fuel cell of Claim 15 wherein the polymer has an IXR of about 23.